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University of Gondar and Addis Continental Institute of Public Health

# Assessment of factors associated with increased level of malaria transmission in focal areas of Western Oromiya, Ethiopia

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## List of acronyms

| | |
|---|---|
| ACT | Artemisinin based Combination Treatment |
| ACIPH | Addis continental institute of public health |
| AIDS | Acquired immuno-deficiency syndrome |
| CNHDE | Center for National Health Development in Ethiopia |
| DHS | Demographic and health Survey |
| EFY | Ethiopia Fiscal Year |
| FGD | Focus Group Discussion |
| FOMH | Federal ministry of health |
| GFATM | Global Fund to fight HIV AIDS Tuberculosis and Malaria |
| HIMAL | Highland malaria project |
| HP | health post |
| IRS | Indoor residual spraying of houses |
| ITN | Insecticide treated net |
| LLIN | Long lasting insecticide treated nets |
| MIS | Malaria indicator survey |
| mm | Millimeter |
| NMCP | National malaria control program |
| NMSA | National meteorological service Agency |
| OPD | Out patient department |
| *P. falciparum* | *Plasmodium falciparum* |
| PPC | Potential preventable cases |
| *P. vivax* | *Plasmodium vivax* |
| RDT | Rapid diagnostic test |
| RHB | Regional health bureau |
| RBM | Roll back malaria |

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## Abstract

**Background**: Malaria is a leading cause of morbidity and mortality in Ethiopia. Over 55 million population live in areas at risk of malaria transmission. Ethiopia is one of the most malaria epidemic prone countries in Africa.

**Objective:** the general objective of this study is to assess factors associated with occurrence of malaria outbreak from September to December 2008 in focal areas of Western Oromia.

**Method:** Both quantitative and qualitative methods were employed. The quantitative method used to describe malaria situation in the study areas and analytic method was used to compare three time periods in the same study area to measure the association of climate variables and intervention coverage with reports of malaria outbreak in the study areas. The study was also supplemented by three focus group discussions. Data collection was done using structured check list for the quantitative part while tap record was used for qualitative component of the study. The data was compiled from MS excel and SPSS was used for data analysis.

**Result:** The monthly malaria reports of 2008 from September to December exceed the 85 percentile threshold level in the study areas. There was significant association between Insecticide Treated Net coverage and report of malaria out break (adjusted odd ratio= 0.703 (0.594-0.832). Indoor Residual Spraying coverage ≥75% has also showed significant association with report of malaria outbreak (adjusted odd ratio= 0.006 (0.0, 0.163). Regarding to climate variables, the maximum Temperature and rainfall with one month lag also showed significant association with reports of malaria outbreak at adjusted OR 6.936 and 1.025 respectively. Minimum Temperature has no association with report of malaria outbreak in this study.

**Conclusion and recommendation:** Reduction in ITN coverage due to worn out of nets and low IRS coverage had contributed for occurrence of malaria outbreak in the presence of favorable climatic condition. Replacement distribution of ITNs and increase the house hold coverage of IRS in targeted villages needs to be an important step in the prevention of malaria outbreak.

## Introduction

In Ethiopia, approximately 55 million people (68%) live in malaria risk areas, chiefly at altitudes below 2,000 meters. Malaria is mainly seasonal with unstable transmission in the highland fringe areas while transmission in lowland areas, river basins and valleys has a relatively longer duration. Ten Regional Health Bureau (RHB) reports also show that annually, between 5 and 6 million clinical malaria cases are reported by health facilities. National estimates of the actual number of cases at the population level are estimated to be on the order of 10–12 million with 60–70% and 30–40% of the cases due to *P.falciparum* and *P. vivax,* respectively (1).

Numerous studies have been conducted in many parts of the country, which clearly demonstrated that the transmission of the disease in the country is unstable, and the population at large lacks immunity. These studies have indicated that malaria is predominantly an epidemic disease in Ethiopia, and that the generally short transmission season (due to the rainfall pattern) and the correspondingly long interval of freedom from infection results in little effective immunity acquired by the population (2).

Ethiopia is also one of the most malaria-epidemic prone countries in Africa. Rates of mortality and morbidity dramatically increases (3-5 fold increase) during epidemics (3).

At the global level, the terms “epidemic” and “outbreak” of malaria have been somewhat less clearly defined, as they typically relate to changes from existing national or local baseline malaria numbers or rates (4). In Ethiopia, as a result of diverse topography and climate, malaria transmission patterns vary considerably geographically, seasonally and between years. The unstable nature of the transmission means that malaria has been considered an “epidemic-prone disease” in Ethiopia. The epidemics or outbreaks are usually focal but large scale devastating epidemics have occurred at intervals of approximately 5-8 years (4). The last major epidemic took place in 2003 but since this, the number of reported epidemics or outbreaks has decreased, and this has been attributed, in part, to the scaling up of malaria interventions (4).

An epidemic (in general) is the occurrence of cases in excess of the number expected in a given place and time period. Practical problems in using this definition, in the case of malaria, include difficulty in knowing what is the "expected" in ascertaining that it has been exceeded (2)

Possible precipitating factors of malaria epidemics outlined as follows according to guideline for malaria epidemic prevention and control in Ethiopia:

a) Increase in vectorial capacity, e.g. importation of a more potent vector.
b) Natural increase, mainly through abnormal rainfall (usually excess, sometimes deficit) and elevation in temperature (which accelerates larval development and hence the emergence of vector; and shortens the malaria incubation period in the vector, hence increases the fraction of infective vectors surviving that period) and humidity (which increases adult longevity).
c) Man-made increase: deterioration of vector control operations, inadequate management of surface waters, insecticide resistance, destruction of cattle and/or houses (e.g. through disaster or war) leading to increased man/vector contact.
d) Immigration of non-immunes into an endemic area.
e) Immigration of infectives into a receptive non-endemic area.
f) Resistance to antimalarial drugs.

Death rates exceeded emergency threshold at 4sites during epidemics of *plasmodium falciparium* malaria in Brundi (2000-2001) and in Ethiopia (2003-2004). Deaths likely from malaria ranged from 1,000 to 8,900 depending on the site, and accounted for 52% to 78% of total deaths. Earlier detection of malaria and better case management are needed (5).

Malaria is considered to be the most important communicable disease in Oromia region. Three quarters of the region, (242 of 261 *woredas* (districts) and 3932 of 6107 *kebeles*, the smallest administrative unit of Ethiopia similar to ward or a neighborhood), are considered malarious, accounting for over 17 million persons at risk of infection. There are 1.5 to 2 million clinical cases per year, with malaria accounting for 20-35% of outpatient consultations, and 16% of hospital admissions. Malaria deaths, at a rate of 18-30%, are the leading cause of all hospital deaths (6).

Malaria transmission intensity, along with its temporal and spatial distribution in Ethiopia, is mainly determined by the diverse eco-climatic conditions. Climatic factors such as temperature, rainfall, and humidity show high variability mainly as a function of altitude and are the most important variables that influence malaria transmission (3).

Based on this altitudinal variation and associated climatic characteristics, areas of the country are categorized into climatic zones, namely, the cold zone locally known as “Dega”; the hot zone, “Kolla”; and areas of average climatic conditions, known as “Weyna Dega.” The cold zone, which covers areas higher than 2,500m above sea level, has a mean annual temperature of 10–15°C. This highland area is considered free of local malaria transmission. The midland area, ranging in altitude from 1,500–2,500m with a mean annual temperature between 15–20°C, has diverse malaria transmission patterns. In the hot lowland zone, located in areas below 1,500m above sea level, where the mean annual temperature varies from 20–25°C, malaria transmission is endemic, and its intensity and duration are mainly dictated by the amount and duration of rainfall (8).

Mean annual precipitation, in general, ranges from 800 to 2200 millimeters (mm) in the highlands (>1,500 meters) and varies from less than 200 to 800mm in the lowlands (<1,500 meters). Rainfall decreases northwards and eastwards from the high rainfall pocket area in the southwest and seasonality is not uniform. The western half of the country has two distinct seasons (wet from June–September and dry from November–February), with the rainfall peak occurring from July to August. The central and most of the eastern part of the country have two rainy periods and one dry period (9).

Due to the unstable and seasonal pattern of malaria transmission, the protective immunity of the population is generally low, and all age groups are at risk of infection and disease.

The Ethiopian National Malaria Control Program (NMCP) is guided by a five-year National Malaria Prevention and Control Strategic Plan, which is in line with the goals of the country's Health Sector Development Plan (HSDP III), the Roll Back Malaria objectives and the Millennium Development Goals (MDGs). The national malaria control program goals are to reduce malaria morbidity and mortality by 50% by the year 2010 and by 75% by the year 2015 compared to year 2000 baseline (10).

A major scale-up of malaria prevention and control activities with wide distribution of rapid diagnostic tests (RDTs), Artemisinin based Combination Treatment (ACTs), Long lasting insecticide treated nets (LLINs) and indoor residual spraying (IRS) was started in 2005. These interventions were targeted to suit local epidemiological situations with case management being made available in all malarious areas while LLINs are primarily targeted for areas below the altitude of 2,000m and IRS targets epidemic prone areas up to 2,500m of altitude (11).

Initial evidence indicated that the combination of mass distribution of LLINs to households and nation wide distribution of ACT in public sector was associated with substantiated declines of in-patient malaria cases (73%) and deaths (62%) in Ethiopia comparing prior to (2001-2005/6) and after 2007 (12). National malaria indicator survey (MIS) conducted in 2007 indicated that in areas altitude less than 2000 meters, 65.6% of house holds have at least one insecticide treated net (ITN), 43.8% children under five slept under ITN the previous night. MIS 2007 also indicated that the malaria parasite prevalence rate in all ages by RDT was estimated to be 1.7% (11).

While the country has been recording significant reduction of malaria morbidity and mortality (12), there are reports of malaria outbreak in 6 focal areas of western Oromiya from September to December 2008. The factors contributing for the occurrence of malaria outbreak in these areas were not clearly defined. The purpose of this paper aims to assess the factors associated for the occurrence of the upsurge of malaria situations in these focal areas. Identifying the factor/s associated with increased level of transmission in these focal areas may contribute in the prevention of control malaria in the region as at the national level.

## Literature review

**Malaria epidemics:**

Plasmodium falciparum malaria epidemics were detected in 41 African sites from 1997 through 2002. A total of 125 million persons are considered at risk for malaria epidemics, with an estimated yearly death rate of 155,000 to 310,000 (13).

In 1958, a malaria epidemic covering over 250,000 square kilometers resulted in an estimated three million cases and 150,000 deaths in Ethiopia. This epidemic was well documented by R. E. Fontaine and others (*American Journal of Tropical Medicine and Hygiene*, 1961, Volume 10, pp 795-803). The altitudinal limits of the epidemic ranged approximately between 1600 to 2150 meters elevation. According to the authors, the main precipitating causes of this epidemic, appears to have been unusual weather conditions in the highland areas of the country. Rainfall exceeded all other previous years on record, and abnormally high atmospheric temperature and relative humidity prevailed during the year (2).

Since 1558 the country experienced large scale malaria epidemics in 1988, 1994/1995, and 1998/1999. From March and December 2003, another serious epidemic had devastating effects in 3,689 villages in 211 districts, resulting in over 6.1 million cases with an estimated 45,000 to114,000 thousand deaths (3).

Paper published on alert threshold algorithms and malaria epidemic detection in Ethiopian situation described as accurate, well-validated system to predict unusual increases in malaria cases are needed to enable timely action by public health officials to control epidemics and mitigate their impact on human health. Four types of alert threshold algorithms are compared: weekly percentile, weekly mean with standard deviation, slide positivist proportion, and slope of weekly cases on log scale. A number of such system have been proposed or implemented. But the comparative utility of these systems for applied public health purposes has not been rigorously established. For example, WHO has advocated the use of alerts when weekly cases exceed the 75$^{th}$ percentile of cases from the same week in the previous years (4). Alert threshold algorithms based on percentiles performed as well as or better than the other algorithms over the range of number of alerts triggered. A relative smaller number of alerts triggered, threshold algorithms based on percentile anticipated the highest percentage of the potential preventable malaria cases of all approaches. The percentile algorithm's good performance relative to the optimal timed alerts indicates that it triggers alerts at the beginning of epidemics rather than in the middle of ongoing epidemics. Given the attractive characteristics of the percentile algorithms, further question is what the percentile level one should use is. Beyond 0.4 to 0.6 alerts/year, the % PPC leveled off because of the peaks with higher number of cases, possibly epidemic periods, were detected with fewer alerts by using 85$^{th}$ to 90$^{th}$ percentiles (4).

**Climate and malaria epidemics:**

The malaria transmission pattern in Ethiopia is characterized by seasonal and cyclic epidemics often reaching large scale proportions causing huge health and socio-economic problems. In the midland zone, where temperature is a determining factor, malaria transmission often occurs in areas below 2,000m, while areas above 2,000m may become affected during epidemics (7).

Average temperature in the previous month and rainfall in the previous two months had a quadratic and linear relations with An. Gambie s.s density respectively, whereas increase in densities of this vector in the previous two months should linear r/n ship with increased malaria incidence. The statistical interaction term b/n average temperature and rainfall in the previous months was highly significant (14).

Paper published on weather prediction of plasmodium *falciparum* malaria in epidemic prone regions in Ethiopia-I , indicated that average treated by each of 10 health facilities ranged from 11-39 malaria cases and over 300 cases during the peak transmission season. Minimum temperature was positively correlate with rainfall, significantly (rho=0.37) in cold districts and non significantly (rho=0.06) in the hot. Maximum temperature, however, was negatively correlated with rainfall, significantly (rho= -0.33) in cold districts and non significant (rho= -0.033) in the hot. In cold districts, rainfall was associated with a delayed increase in malaria cases, while the association in hot districts occurred at relatively shorter lags. In cold districts, minimum temperature was associated with malaria cases with delayed effect. In hot districts, the effect of minimum temperature was not significant at most lags, and its contribution was relatively immediate. Maximum temperature is not significantly associated with the estimate of malaria cases in either of the group of districts (4).

**Malaria interventions coverage:**

In 2005, the global malaria community committed itself to the goal of reducing the global malaria by at least 50% by 2010 (15). The recommended method to achieve this target is > 80% coverage of the main malaria control tool: long lasting insecticide treated bed nets (LLINs), indoor residual spraying (IRS), and treatment with effective medicines, principally artemisinin-based combination therapy (ACT).

Starting from low baseline in 2005, Ethiopia is now engaged in efforts at rapidly scaled up to reach the 2010 coverage targets. Families who have at least one ITN in malaria risk areas in Ethiopia have improved from 5.8% in 2005 (16) to 65.6% in 2007 (11). Ethiopia's 2007 ITN coverage is the highest in all sub Saharan countries after Togo and Sierra Leone (10).

A long-lasting insecticidal net (LLIN) is a factory-treated mosquito net made with netting material that has insecticide incorporated within or bound around the fibers. The net must retain its effective biological activity without re-treatment for at least 20 WHO standard washes under laboratory conditions and three years of recommended use under field conditions (17).

Ethiopia 2007 national malaria indicator survey indicated that the utilization of ITNs among children and pregnant women in household who posses at least one ITN was 61.1% and 65.7% while considering household with or without ITN possession the utilization rate for children and pregnant women 43.8% and 42.7% respectively (11).

House hold survey was conducted by Centre National Health Development in Ethiopia at end of 2005 and end of 2007 to evaluate the health extension program in Ethiopia. The survey in 2005 showed that 41% of house holds possessed at least one ITN and 94.5% were in good condition. The second survey conducted in the end of 2007 showed that 76.1% of house holds have at least one net and 83.5 % of nets were in good conditions.

The study conducted by Albert Kilian in rural Uganda, 50% of nets had any holes after only one year and more than 75% after 2 years (18). The hole index captures not only the presence or absence of holes but also takes into account number and size. The mean hole index increased linearly during the first 3 years of net follow up with a mean of 4.4 (95% CI 3.8-4.5) after one year (all nets combined), 7.5 (6.7-8.4) after two years and 12.4 (10.7-14.1) after 3 years. After three years it appears to increase more rapidly reaching 20.4 (16.2-24.6).

In the same paper it was reported that 58.2% loss of chemical was found in the second generation LLIN after three years. On the other hand, the loss was 59% after 20 washes in the laboratory washing study by Yates at al (18).

Study conducted by WHO documents for the first time marked reductions in malaria cases and deaths in health facilities in two medium and large sized countries (Rwanda and Ethiopia) following large scale distribution of LLIN and ACT. In patient malaria cases and deaths in children <5 years old in Rwanda fell by 55% and 67%,respectively and in Ethiopia by 73% and 62% comparing prior to (2001-2005/6) and after 2007. Over this same time period, non malaria cases and deaths generally remained stable or increased (12).

Indoor Residual Spraying of houses is currently targeted to cover epidemic-prone areas and malaria-affected communities. The Federal Ministry of Health estimates that 30% of IRS-targeted areas have been sprayed in 2007 and in 2008 the coverage has been increased to 50% (19). IRS for community protection, and given its mode of action, the highest possible level of coverage is required to achieve the maximum impact of malaria transmission (17).

Environmental control will be implemented where appropriate, and based on further risk mapping exercises. This will include mobilizing communities to remove larval breeding sites and vector larvae positive sites will be treated with anti-larval chemicals (19).

Although past high land malaria epidemics have been shown to occur within defined altitudinal limits and have often been linked casually to climatic anomalies, the current malaria outbreak happened following scaling up of malaria control interventions. What factors were contributing for the occurrence of malaria outbreak? Was it due to climate factors or deterioration of malaria interventions in these areas or both? It will be very important to understand the reason for increasing the level of malaria transmission in these focal areas in Ethiopia where the country have been recorded to significant progress to improve malaria intervention coverage such as ITN distribution, Indoor Residual Spraying (IRS) and early and prompt effective treatment of malaria.

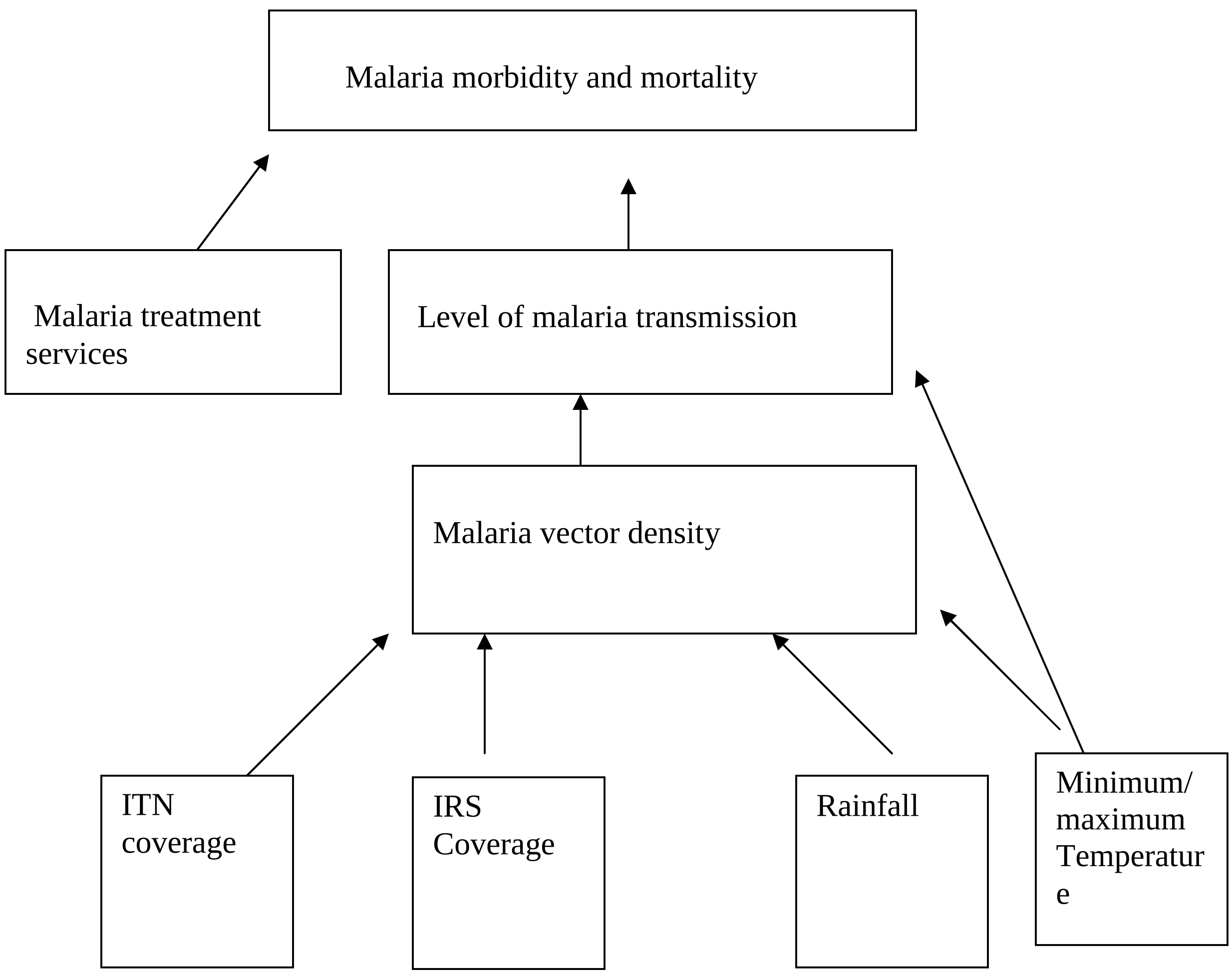



Figure 1. Conceptual Framework for the study of major factors for increased level of malaria transmission

## Objectives

***General:***

- To assess factors associated with the occurrence of malaria outbreak from September to December 2008 in focal areas in Western Oromiya, Ethiopia.

***Specific:***

- To describe the malaria situation in the study areas
- To describe the relationship between climate variables (rainfall, temperature) as well as malaria intervention coverage with outpatient malaria consultations in 2006, 2007 and 2008.
- To measure association between climate variables (temperature, rainfall), malaria interventions coverage (ITNs, IRS) with the report of malaria outbreak in selected areas in 2006, 2007 and 2008.

## Methods

### Study area and period:

The study was conducted in 6 woredas of 3 zones of Western part of Oromiya region where malaria outbreaks have been reported by the woreda health offices. The study conducted from April to June 2009.

Figure 2: Map of study areas indicating districts reported malaria outbreak, 2008.

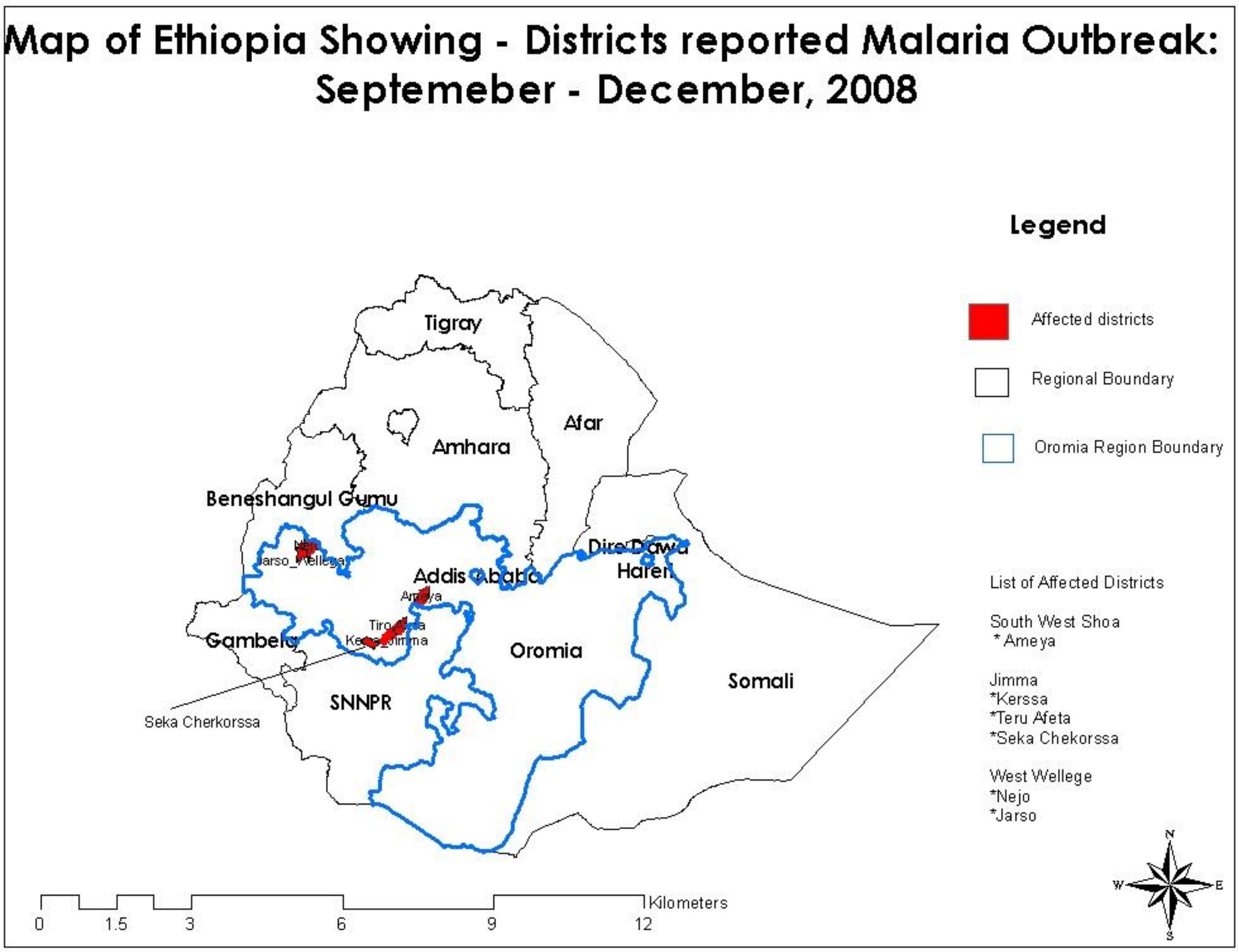


Table 1: List of study areas by zone and district, 2008

| **zone** | **Woreda** | **Village** |
|---|---|---|
| South West Shoa | Ameya | Gumbere |
| | | Kotta |
| Jimma | Keressa | Bulbul |
| | Teru Afeta | Kotecha Gibe |
| | | Ayeno |
| | Seka Chekorsa | Debo yaya |
| | | Boyo ketechema |
| | | Kossare |
| | | Bore |
| | | Koffee |
| West Wollega | Nedjo | Nedjo town |
| | Jaresso | J/Gabaa dafin |
| | | Babo Garjo |

**Study design**

The study design used was comparison of three time periods (2006 to 2008) of same study areas to measure association between reports of malaria outbreak with climate variables and malaria interventions coverage and supplemented by focus group discussion.

**Study population:**

The study population for this study was villages /kebeles which were affected by malaria outbreak from September to December 2008 in west Oromia.

**Sample Size:**

All villages in the study area reported malaria outbreak in 2008 were planned to include in this study. Total of 15 villages in 7 woredas were reported malaria outbreak in September to December 2008. Data collected from 6 woredas and 13 villages except in Borecha woreda where accessibility to road transportation to villages was difficult for data collection.

**Data collection:**

For quantitative method, the following data were collected using data collection format (Annex 1) for the year 2006, 2007 and 2008:

a) Climate data: daily meteorological data (minimum, maximum temperature and rainfall) recorded at the local weather station nearest to the health facility were obtained from National Meteorological Agency (NMSA) for the same period. These daily data were compiled in to mean monthly minimum and maximum temperature and total monthly rainfall.

b) Health facility data: monthly outpatient malaria morbidity data, when the data was available confirmed results of plasmodium species was collected. The data was collected from health facilities record. A report for the occurrence of malaria outbreak to villages was also collected from woreda health offices.

c) Malaria intervention coverage data: ITN coverage and IRS coverage for each village was collected from respective woreda health offices.

Data collectors are 2 health officers and one nurse, who received orientation for one day how to collect data from health facilities records and reports of woreda health office using data collection format (see annex 1). The investigator was playing supervisory role during data collection.

The data consist of the occurrence of malaria outbreak for the months of September to December in 2006 to 2008 using the woreda health office reports. Additional data was also collected for coverage for insecticide treated net and indoor residual spray of DDT as well as climate data such as monthly mean maximum temperature, monthly minimum temperature and cumulative monthly rainfall.

The ITN coverage for the year of net distribution was collected from woreda health offices, then the coverage of the next two or three years was determined using the assumption that after the end of one year 15% of net will lost function or damaged. After the end of the second and third year additional 20% and 25% loss of nets was assumed (18). The basis of this assumption was based on the household survey conducted in 2005 by Center for National Health Development in Ethiopia (CNHDE) which indicated that after 4 to 5months of net distribution (Mass ITN distribution began mid 2005 and study was conducted last month of 2005) the nets conditions was 94.5%. This means that in 4 to 5 months 5.5% of nets were lost. So after one year 15% of ITN coverage reduction was assumed. Subsequently, the lost rate assumed to increase by 20% and 25% after the second and third years of distribution (18, 21).

Variables:

Dependent variables

- Report of malaria outbreak (yes, no)

Independent variables

- mean monthly minimum temperature
- mean monthly maximum temperature

- monthly cumulative rainfall
- ITN distribution coverage (administrative)
- IRS coverage

The dependant variable for malaria outbreak used to have values as Yes or No (dichotomous). In 2008, all villages in the study area were reported malaria outbreak (was coded as 1or yes) from month of September to December. While in 2007 and 2008 all villages in the study areas were not reported malaria outbreak (was coded as zero or no) from September to December.

Climate variables and ITN administrative coverage are continuous variables while IRS coverage was categorized to four levels. Zero group for villages did not conduct IRS operation at all for that specific year; group one for IRS coverage b/n 0 and 34%; group two for coverage b/n 35 % and 74% and group three for IRS coverage $\geq$75%. WHO recommends villages targeted for IRS operation should be covered with high coverage up to 75% or more to get impact on prevention and control of malaria (14). See annex-2 for data entry format used.

Study villages were given values for each month of only September to December. This is because the study sites were selected based on woreda health office reports of malaria out break in the major malaria transmission season covering from month of September to December. Accordingly the data set has total of 168 values for dependant variables of which 52 were with report of malaria outbreak and 116 were with out malaria outbreak.

Regarding to qualitative method of data collection, three focus group discussions were conducted. FGDs were conducted in Gumbere rural village of Ameya woreda of South West

Shoa zone, in B/ kechema rural village of Sekacheckoresa woreda of Jimma zone and J/Gabaa dafin rural village of Jaresso woreda of West Wollega zone. Discussions were facilitated by health officer in two sites and a nurse in the other site who are fluent in Oromifa and focus group discussion guide of Oromifa version was used as tool (see Annex 4). The discussions were tape recorded and translated from Oromifa to Amharic and then to English.

**Data processing and analysis**

SPSS version 16 was used for analysis and MS Excel used for data compilation. Simple frequency tables, graphs were used to describe the different variables. The association of a variable with dependant variable was checked with bivariat analysis. Further analysis was also made to see the association of independent variables with the dependant variable using Binomial logistic regression analysis. The interaction between rainfall and temperature was check if there was significant association with the occurrence of malaria outbreak.

For the qualitative part, transcripts of focus group discussion were coded and were highlighted to summarize important findings for analysis.

**Data quality assurance:**

For quantitative data, the data collection formats was checked for completeness by the supervisor on daily basis. Training for data collectors was done for one day. Five percent of the collected data was checked by the supervisor for the accuracy and completeness of data collection.

**Operational definition**

1. Malaria out break: woreda health bureau report of presence for malaria outbreak or malaria epidemics in specific village and time period
2. 85 percentile: from malaria cases reported in a specific month of years, the value indicated from set observation at 85 percentile is 85% of the observations are below and 15% of observations are above the indicated value.
3. Village: minimum administrative unit in the country and interchangeable used for "Kebele".
4. ITN coverage: percentage of households in malaria risk areas receiving 2 insecticide treated nets from all house holds in study village for specific year
5. IRS coverage: percentage of households sprayed with indoor residual spraying of houses from all households in study village for specified year

**Ethical consideration**

Ethical clearance received from University of Gondar ethical review committee. Support letter was provided by Oromiya RHB to woreda health offices selected for this study. Verbal consent also was received from voluntary participants of FGD otherwise the rest of the data were secondary data from health facilities and meteorological stations, which didn't required consents. Any identification including individuals and organization information will be maintained an anonymous.

**Dissemination of results**

The result of this study will be presented to Malaria control support team in the federal ministry of health where most of the malaria prevention and control s stakeholders expected to participate in this regular meeting. Presentation of the result of this paper to this meeting may give additional evidence to refine the prevention and early detection of malaria outbreak in Ethiopia's context. Similar presentation will be conducted to Oromia RHB and partners working in malaria in the region.

## Results

**Description of the study sites:**
The study sites have altitude ranging from 1722 to 1863 meters which corresponds to typical malaria epidemic prone areas of the country. The average annual mean minimum temperature and maximum temperature ranges from 11.6 to 13.7 °C and 25.1 to 28.0°C respectively. The annual rainfall ranges from 1098 to 1555mm.

The data set consists of three to five years of malaria OPD reported cases (depending on the availability of data) with the corresponding intervention coverage and climate variables.

Table 2: Climate data by district , West Oromia, Ethiopia, 2006 to 2008

| **District** | **Mean monthly maximum temperature (°C) 2006 to 2008** | **Mean monthly minimum temperature (°C) 2006 to 2008** | **Annual rainfall, mm** |
|---|---|---|---|
| Ameya | 25.1 | 13.7 | 1264 |
| Kerssa | 27.4 | 12.2 | 1218 |
| Tiru Afeta | 26.1 | 13.1 | 1369.7 |
| Seka Chekoressa | 28 | 12.0 | 1555 |
| Nedjo | 26.6 | 11.6 | 1558 |
| Jaresso | 26.6 | 11.6 | 1098 |

The study areas are malarious with two malaria transmission seasons. The major malaria transmission season covers from September to December following the main rainy season from June to August. The minor transmission season covers from May to June following the short rainy season from March to April. The area experienced malaria epidemic in 2002-2003 which was relatively covering wider areas. Since then focal outbreak has been reported in September to December 2008. Some of the villages even reported outbreaks three to four months earlier in

May to June 2007 during the short transmission season (e.g Kota, Gumbere). The dominant malaria parasite is *Plasmodium* f*alciparium* and followed by *P.vivax*. According to the national malaria epidemic prevention and control guideline health facilities should use norm chart to compute weekly malaria data and compare to the previous five years malaria data. When it exceeds the second largest numbers from the previous data the health facility should notify as malaria outbreak to the woreda health office for investigation and response. However, this is not practically implemented due to lack of five years data in most health facilities, norm chart was not available in some of health facilities or health workers don't use the norm chart even in health facilities where it was available due to lack of knowledge or not understand the importance of using it in early detection. As a result, malaria outbreak detection is usually delayed. This paper uses to categorize villages as reported malaria outbreak or not based on woreda health office report.

Malaria prevention and control activities in these areas included distribution of insecticide treated nets (ITNs), indoor residual spraying of houses of DDT, prompt and effective treatment of malaria at health facilities and environmental management. ITNs had been distributed in all villages in the study areas. The distribution of insecticide treated nets was conducted in 2006 in all villages except Nedjo town where the community received nets in 2007 (see village level ITN and IRS coverage on table 3).

Malaria epidemic control activities were also implemented in affected villages. The major activities include mass fever treatment campaign using Coartem. Fever cases were searched house to house and Coartem treatment was provided. In areas where transmission was thought to be intense, mass treatment using Coartem to communities with fever and even without fever was conducted. Environmental management was also conducted through community mobilization in all affected villages though the guidance of the health extension workers.

Table 3: ITN and IRS coverage, altitude by village, West Oromia, 2006-2008

| **District** | **Villages** | **Altitude (meter)** | **ITN coverage (%)** | | | **IRS coverage (%)** | | |
|---|---|---|---|---|---|---|---|---|
| | | | **2006** | **2007** | **2008** | **2006** | **2007** | **2008** |
| Ameya | Gumbere | 1746 | 85 | 65 | 40 | 77.8 | 74.5 | 80.6 |
| | Kotta | 1722 | 85 | 65 | 40 | 0 | 0 | 78.3 |
| Kerssa | Bulbul | 1731 | 85 | 65 | 40 | 52.4 | 45.4 | 85.4 |
| Teru Afeta | Kotecha Gibe | 1755 | 65.7 | 45.7 | 20.7 | 63 | 52.6 | 58.3 |
| | Ayeno | 1788 | 69.5 | 49.4 | 24.5 | 56.8 | 61 | 53.7 |
| Seka Chekoresa | Debo yaya | 1771 | 83 | 68 | 48 | 70 | 70 | 55 |
| | Boyo ketechema | 1735 | 82 | 67 | 47 | 81.5 | 0 | 72 |
| | Kossare | 1736 | 99 | 84 | 64 | 92 | 0 | 91 |
| | Bore | 1780 | 78 | 63 | 43 | 68.5 | 63.5 | 29.4 |
| | Koffee | 1777 | 93 | 78 | 58 | 72 | 68 | 62 |
| Nedjo | Nedjo town | 1863 | 0 | 66.2 | 51 | 0 | 0 | 25.5 |
| Jaresso | J/Gabaa dafin | 1746 | 73 | 48 | 28 | 0 | 0 | 47.7 |
| | Babo Garjo | 1738 | 85 | 65 | 40 | 91.6 | 94.4 | 57.2 |

Below graphs describe monthly reported malaria out patient cases with 85 percentile of the previous reported cases (threshold level to malaria outbreak) and also to check whether woreda health report of malaria outbreak is correct. The graph showed September to December 2008 malaria reported cases exceed the 85 percentile of the previous malaria reported cases in the study areas.

Figure 3: Graph comparing Malaria OPD reported cases (2005-2009) with 85 percentile in Kotta HP, Ameya woreda, Oromia

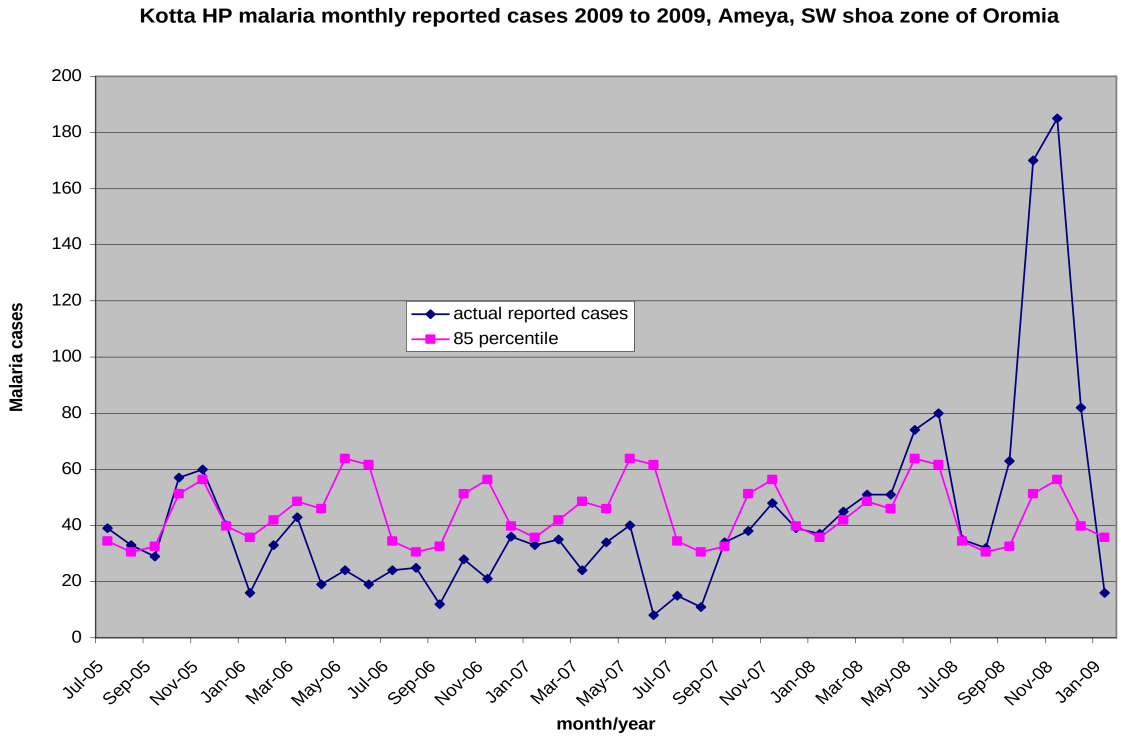



Figure 4: Graph comparing Malaria OPD reported cases (2005-2009) with 85 percentile in Gumbere HP, Ameya woreda, Oromia

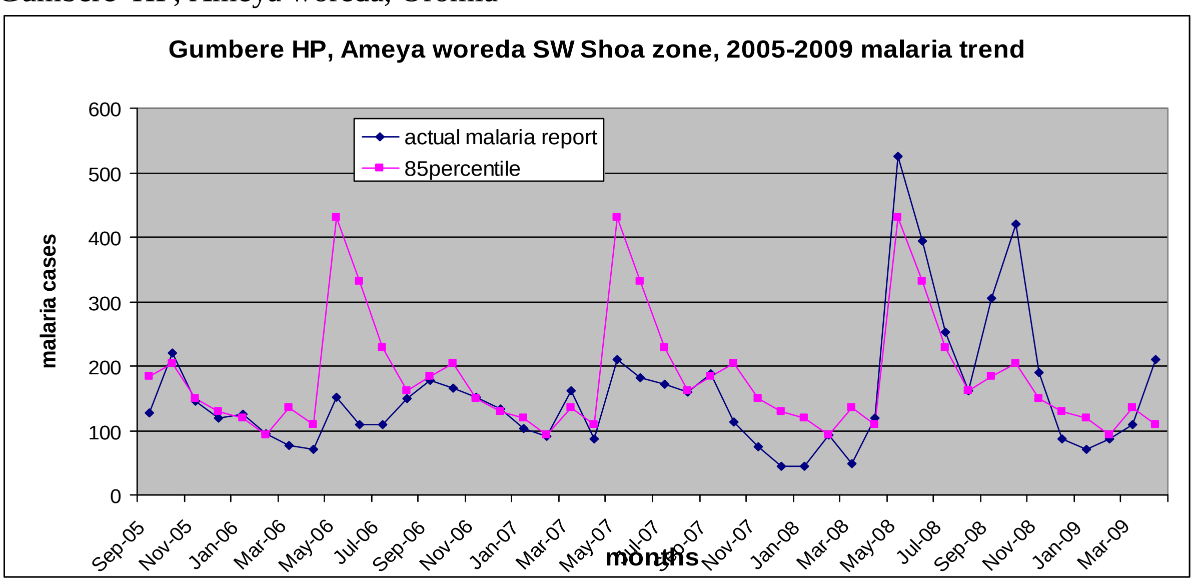


Figure 5: Graph comparing Malaria OPD reported cases (2003-2009) with 85 percentile in Bulbul health post, Kerssa woreda , Jimma zone, Oromia region

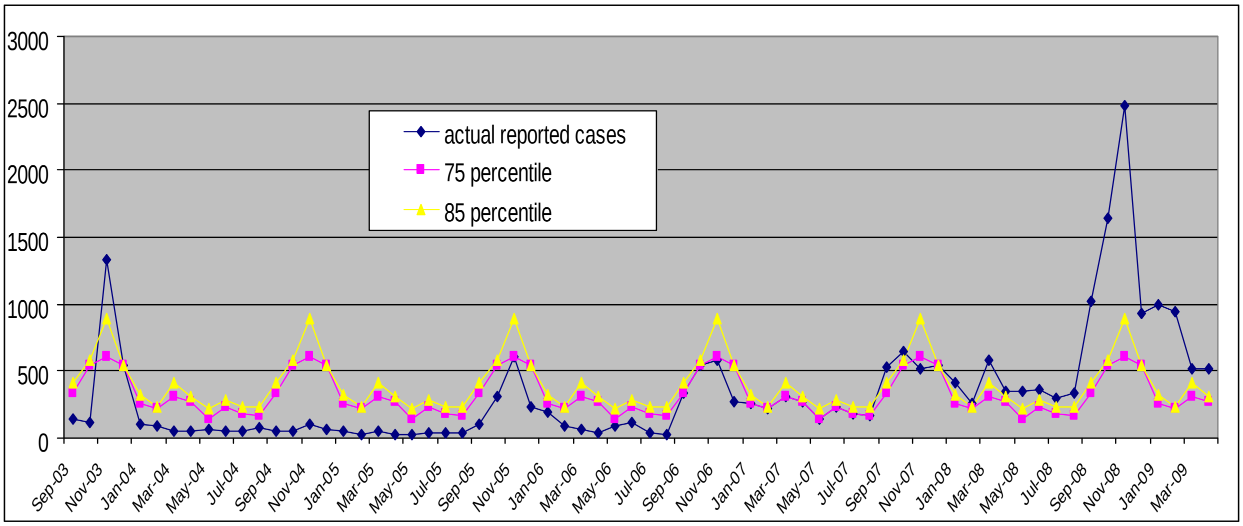
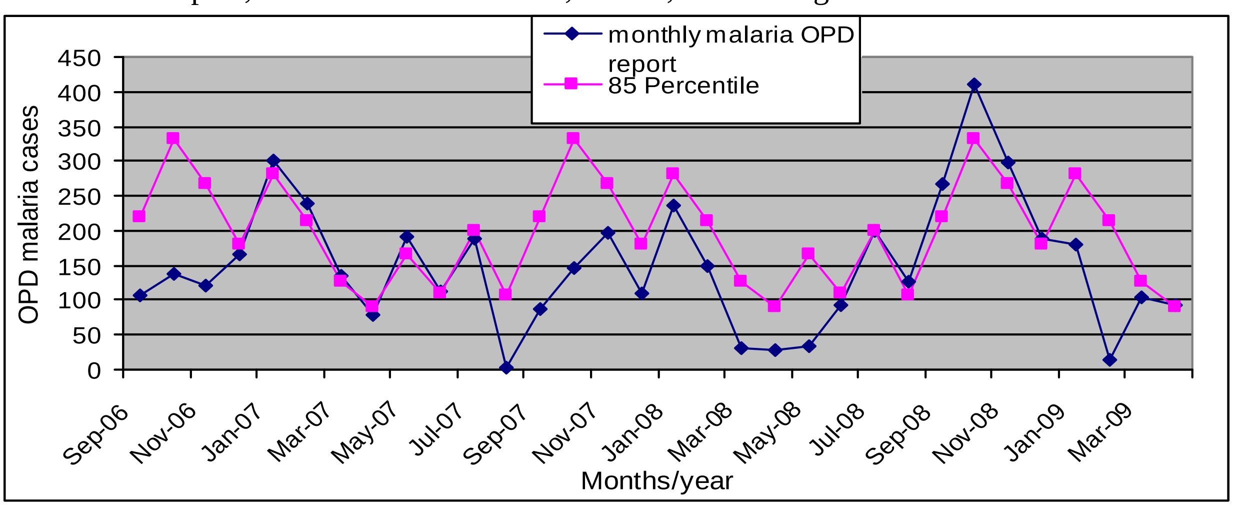



Figure 6: Graph comparing Malaria OPD reported cases (2006-2009) with 85 percentile in Kossare health post, Sekachekoressa woreda, Jimma, Oromia region



Below graphs compare ring the intervention coverage (IRS, ITN) with malaria OPD reported cases.

Figure 7: Graph comparing Malaria OPD reported cases (2006-2009) with ITN coverage and IRS Coverage in Gumbere HP, Ameya woreda,

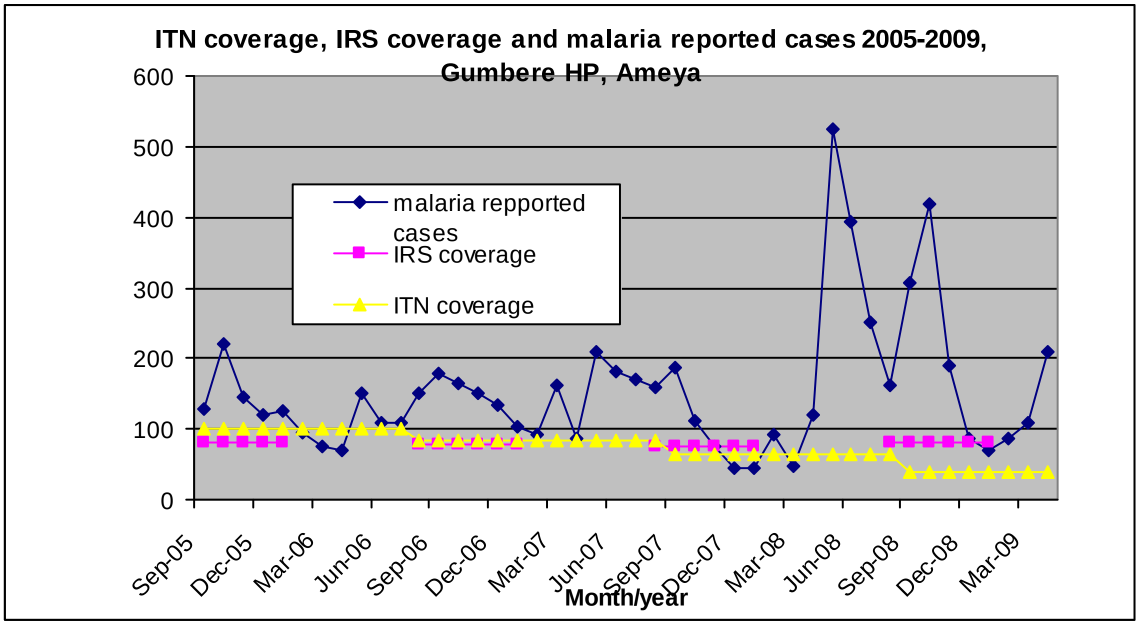


Figure 8: Graph comparing Malaria OPD reported cases (2006-2009) with ITN coverage and IRS Coverage in Debo Yaya HP, S.Chekoresa woreda,

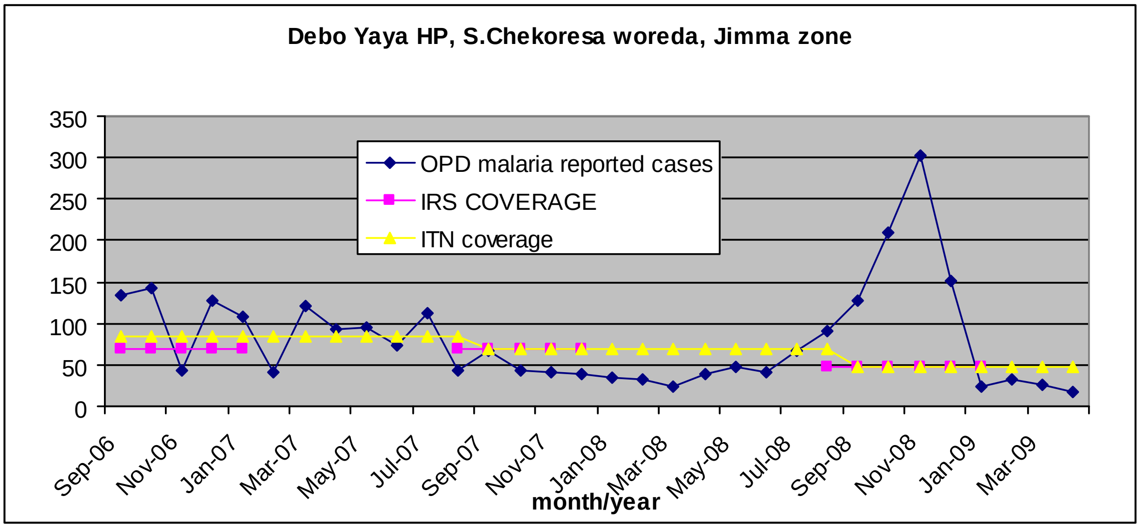



Figure 9: Graph comparing Malaria OPD reported cases (2006-2009) with ITN coverage and IRS Coverage in Kotta HP, Ameya woreda,

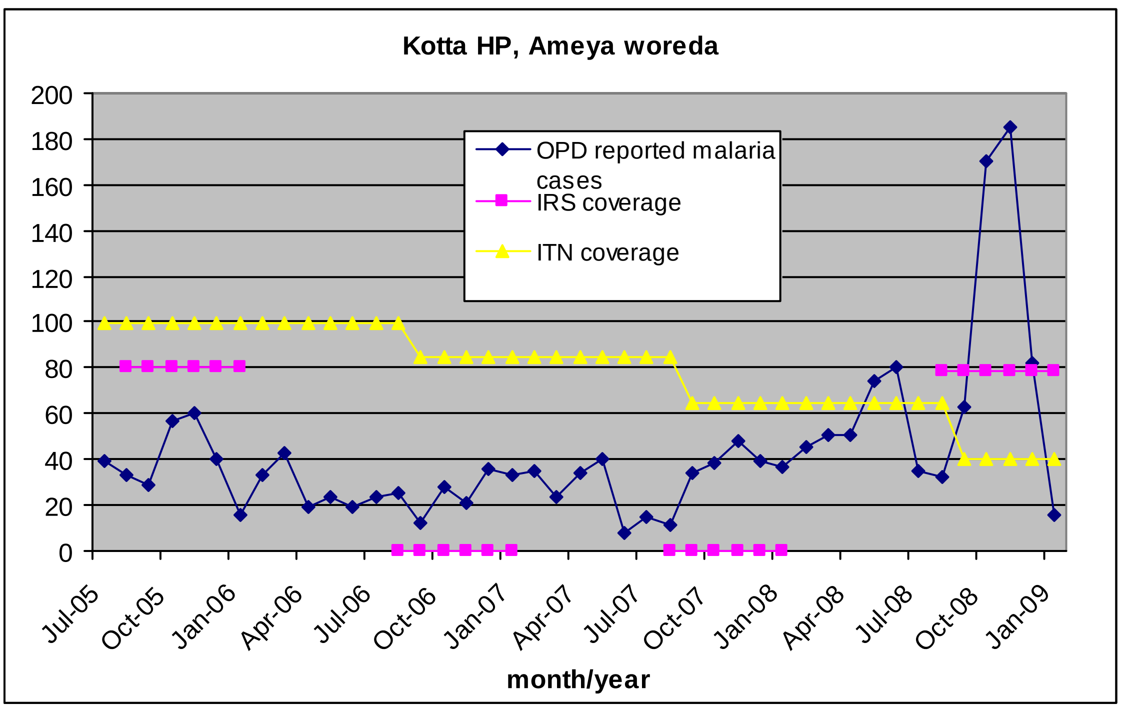
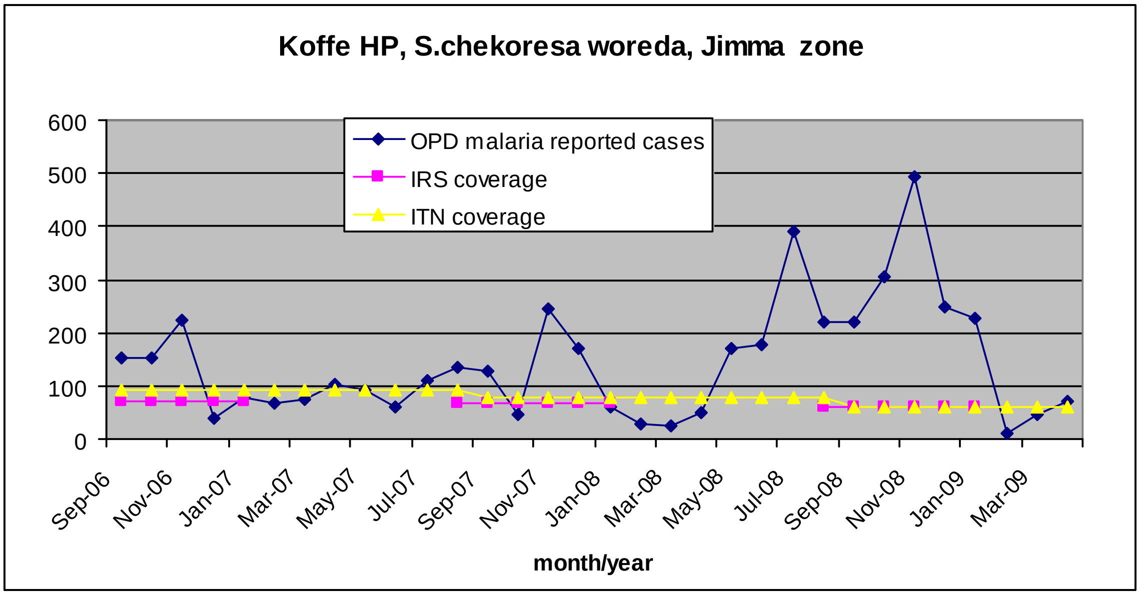


Figure 10: Graph comparing Malaria OPD reported cases (2006-2009) with ITN coverage and IRS Coverage in Koffe HP, S.Chekoresa woreda,




**Association between malaria outbreak and climate variables and malaria interventions:**

Analysis using binary logistic regression showed that there was significant relation ship between increased rainfall (one month lag) and occurrence of malaria out break (Sig. 0.008, adjusted OR 1.025. Similar result was observed for increased maximum temperature (one month lag) and report of malaria outbreak (Sig. 0.002, adjusted OR 6.936). However, there is no significant association between minimum temperature (no lag, one month lag, two month lag were all looked) and report of malaria outbreak in this study.

Regard to malaria interventions, ITN coverage has significantly associated with report of malaria out break. Increase in coverage of ITN reduce the occurrence of malaria outbreak (Sig. 0.00, adjusted odd ratio= 0.703). Similarly IRS equal or more than 75 % coverage has also significant association negatively with report of malaria outbreak (Sig. 0.003, adjusted odd ratio= 0. .006)

Table 4: Association between of intervention coverage (IRS, ITN coverage) and climate variables at one month lag (Min T, Max T, rainfall) with reports of malaria outbreak, Oromia, 2006-2008

| | | | 95.0% C.I. for adjusted OR | |
|---|---|---|---|---|
| variables | Sig. | Adjusted OR | Lower | Upper |
| ITN coverage | 0.000 | 0.703 | 0.594 | 0.832 |
| Monthly cumulative rainfall | 0.008 | 1.025 | 1.006 | 1.043 |
| Monthly mean Max T | 0.002 | 6.936 | 2.062 | 23.327 |
| Monthly mean Min T | 0.419 | 1.300 | 0.688 | 2.456 |
| IRS zero coverage | 0.028 | | | |
| 0<IRS coverage< 35% | 0.994 | 0.000 | 0.000 | |
| IRS coverage b/n 35% and 74% | 0.999 | 2.101E7 | 0.000 | |
| IRS coverage≥75% | 0.003 | 0.006 | 0.000 | 0.163 |

**Interaction between temperature and rainfall:**

Table 5**:** Association between intervention coverage, climate variables and interaction between rainfall and maximum temperature with reports of malaria outbreak, West Oromia, 2006-2008.

| variables | Sig. | Adjusted OR | 95.0% C.I. for adjusted OR | |
|---|---|---|---|---|
| | | | Lower | Upper |
| ITN coverage | .000 | .662 | .528 | .830 |
| Monthly cumulative rainfall | .087 | .828 | .668 | 1.028 |
| Monthly mean Max T | .427 | 2.043 | .350 | 11.921 |
| Monthly mean Min T | .595 | .780 | .312 | 1.950 |
| IRS zero coverage | .031 | | | |
| 0<IRS coverage< 35% | .993 | .000 | .000 | |
| IRS coverage b/n 35% and 74% | .999 | 9900143.176 | .000 | |
| IRS coverage≥75% | .003 | .003 | .000 | .129 |
| Interaction b/n Max Temp and Rainfall | .055 | 1.009 | 1.000 | 1.017 |

We have checked if there was interaction between rainfall and temperature (one month lag) associated with the increased level of malaria transmission in the study areas. The result shows there was significant association between interaction of maximum temperature and cumulative rainfall (Sig. 0.055 adjusted OR= 1.009) but no significant association between rainfall and minimum temperature. In the presence of max temperature and rainfall interaction, ITN coverage and IRS coverage ≥ 75% have again significant association as see table.

The model best fits, using, Hosmer and Lemeshow Test, for this study consist of all independent variables without the interaction b/n climate variables.

**Result of FGD:**

Three Focus group discussions were conducted in Gumbore, Boyo ketchema and J/Gabaa dafin of Ameya, Sekachekoresa and Jaresso woreda respectively. Focus group discussion participants were all male and head of houses. The language used for discussion was Oromifa and the discussion was facilitated by health officer or nurse who is fluent speakers of Afan Oromo. Participants are all farmers who live in area for long years and have similar characteristics interims of age group, level of education and economic status. In each discussion minimum of 10 and maximum of 13 participants were included.

Generally participants have agreed on malaria burden has shown reduction compared to the situation of five years ago. The villages FGD conducted were affected by malaria epidemics in 2003 and it was noted that the situation was explained as it was affected larger portion of the communities. It was also indicated that there was malaria outbreak in 2008 in the 2 FGDs where as in one FGD it was reported that there was outbreak in 2007.

In regard to malaria prevention and control activities, participants pointed out that the most of nets are now very old, damaged and the chemical can't kill insects as they received nets three years ago. One of the participants reported " **The nets are old, damaged and due to washing & the chemical now is not working, not able to kill the insects as it used to be before**." They have also emphasized the importance of ITNs as **"The disease is common among those who don't have bed net."**

DDT spraying is going on smoothly conducted and useful, communities don't have major issues. The treatment of malaria by health extension workers was noted as a good step but there was no antimalaria drug preparation by injection form which is the participants believe was creating difficulty to provide treatment for children under five years of age. Currently antimalarial tablet is provided to children by crushing and dissolving the tablet in a glass of water. The importance of traditional treatment such as use of onion was indicated as importance remedies to malaria.

Heavy rain was indicated as a factor for increased malaria transmission in FGD Jaresso woreda, and untimely rain was also reported in Seka Chekoressa. They don't observe any significant change with regard to temperature.

## Discussion

The major malaria transmission season which extends from September to December is the most important period for the occurrence of malaria outbreak in Ethiopia. Identifying malaria outbreak from seasonal expected level of malaria transmission is a usual challenge for woreda health experts. For this paper we used the presence or absence of malaria outbreak based on woreda health bureau report of malaria outbreak. Using the malaria monthly OPD data we have checked the validity of the woreda report using 85 percentile as threshold level. This paper uses 85 percentile as best threshold level rather than 75 percentile (third quartile) as the latter is more sensitive and less specific compare to 85 percentile (20).

The figure (3 to 6) indicate that in the major malaria transmission season of the year 2008, the number of OPD reported malaria cases exceed the threshold level of 85 percentile which indicates the presence of malaria outbreak in 2008. This result is also consistent with woreda health office report of malaria outbreak in the study areas. In similar studies conducted in Ethiopia, 85% threshold level was found to be the best method of detecting malaria outbreak than the other methods (20).

The malaria outbreaks reported in the study areas assumed to have multiple factors contributions. The findings are generally consistent with hypothesis based on the relation ship between climate factors with mosquito and parasite development.

The biology of the vector and malaria parasite doesn't show immediate effect from climate variables such as temperature and rainfall on increase level of malaria transmission. It rather requires weeks for vectors to breed and transmit the malaria parasite from one person to the other. Once the parasite entered to human, it again needs incubation period for the person to be symptomatic. Therefore, Temperature and rainfall need lag period to affect malaria transmission. This paper looked the association of different scenarios of lag time for temperature and rainfall variables. Temperature and rainfall without lag, with one month lag and two months lag were checked. It was found that the one month (4 weeks) lag time for Temperature and rainfall has significant association with reports of malaria outbreak. This is also consistence to other studies conducted in Ethiopia and Eastern Africa (4).

Using multiple regression ITN coverage, IRS coverage $\geq$ 75%, Max Temp (one month lag) and rainfall (one month lag) showed significant association. One of the most striking uncertainties in the literature on weather factors and malaria is the variability in the reported relation ship between rainfall and malaria, with several studies showing the importance of rainfall as the precipitating factor for malaria transmission while other studies shows that negative or neutral effect (4). For rainfall to have positive effect on increased level of malaria transmission, the temperature should be warm enough to support mosquito and parasite development (4). As the data confirms both rainfall and maximum temperature has significant association. There was favorable rainfall and maximum temperature for the mosquito breeding and for the development of malaria parasite.

However, minimum temperature has no significant association in this study. The role of minimum temperature when it is lower, it limits the development of the malaria parasite in the mosquito (sporogony cycle). Lower minimum temperature also can slow the life cycle of the vector (mosquito). In similar study conducted in Ethiopia, highland fringe areas minimum temperature was associated with malaria cases with delayed effect. In hot districts, the effect of minimum temperature was not significant at most lags, and its contribution was relatively immediate. Maximum temperature was not significantly associated with the estimate of malaria cases in either of the group of districts (4). There is interaction between max temperature and rainfall although not significant at level below 0.05%.

Further more, low malaria interventions coverage have significantly associated with malaria outbreak. The association between reduction on ITN coverage following the year of ITN distribution due to damaged or worn out as well as loss of chemical after washing. In most of study villages, ITNs have been distributed in 2006 and malaria outbreak was reported in the 3rd year of distribution where most of the nets have finished their lifespan. The assumption of lost rate of nets per year used based on study conducted by CNHDE and Alibert K (18, 21). Further study required to determine the exact lost rate of ITNs in Ethiopia and also the utilization of nets.

Indoor residual spraying of houses with DDT coverage over 75% has significant association in reducing malaria outbreak while coverage below that level has no significant association in this study. This finding is consistent with WHO recommendation which stated that indoor residual spraying of houses need to get high coverage of house holds in targeted villages to more than 75% coverage to get significant impact on the prevention of malaria out break (17 ).

**Strengths and limitations:**

The strengths of the study are it was supplemented by focus group discussions (FGDs), multiple factors from climate variables and intervention coverage were considered and multivariate analysis was employed.

Due to limitation of resources the study covered only West Oromia and it would have cover malaria outbreak reports in other part of the country. Meteorological data was collected from near by meteorological stations with radius of up to 15 Kms when there was no station in the study area. The other limitation of the study was malaria outbreak affected areas were not compared with non affected areas using cases control study design, rather the study used self control design looking the same village affected in 2008 used as control in 2006 and 2007 .

## Conclusion and Recommendation

**Conclusion:**

The findings are consistent with the initial hypothesis that reduction of ITN coverage due to worn out and failure of timely replacement of ITNs and IRS spraying below the recommended coverage of households (<75%) in the presence of favorable climatic conditions are major factor associated for the occurrence of malaria outbreak in the study sites.

**Recommendation:**

- IRS operation should be improved to higher coverage of households in targeted villages up to 75% or more. To improve the coverage of households the necessary resources should be allocated.
- Replacement distribution for worn out of ITNs should be priority for malaria prevention and control program to prevent the occurrence of malaria outbreak
- Further studies required to determine precisely longevity of ITNs in Ethiopia context

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# Annexes

## *Annex-1 Data collection format from health facilities/Woreda health offices*

**2001 EFY (2008/9GC data collection)**
Region…………zone……………………woreda……………………
Name of health facility…………………. Population of catchments area
Name of village/s covered by health facilities……………………
Altitude…………………………
ITN distribution coverage (administrative)………………
Month/year of ITN distribution…………………………
ITN utilization rate (if available)………………………..
IRS coverage ……………………………………………

Monthly out patient malaria report from health facility

| Month | Total OPD | Total malaria cases | Total Confirmed cases | Total Plasmodium falciparium |
|---|---|---|---|---|
| July | | | | |
| August | | | | |
| September | | | | |
| October | | | | |
| November | | | | |
| December | | | | |
| January | | | | |
| February | | | | |
| March | | | | |
| April | | | | |
| May | | | | |
| June | | | | |

**2000 EFY (2007/8GC data collection)**
Region…………zone……………………woreda……………………
Name of health facility…………………. Population of catchments area
Name of village/s covered by health facilities……………………
Altitude…………………………
ITN distribution coverage (administrative)………………

Month/year of ITN distribution…………………………
ITN utilization rate (if available)………………………..
IRS coverage ……………………………………………

Monthly out patient malaria report from health facility

| Month | Total OPD | Total malaria cases | Total Confirmed cases | Total Plasmodium falciparium |
|---|---|---|---|---|
| July | | | | |
| August | | | | |
| September | | | | |
| October | | | | |
| November | | | | |
| December | | | | |
| January | | | | |
| February | | | | |
| March | | | | |
| April | | | | |
| May | | | | |
| June | | | | |

**1999 EFY (2006/7GC data collection)**
Region…………zone……………………woreda……………………
Name of health facility…………………. Population of catchments area
Name of village/s covered by health facilities……………………
Altitude…………………………
ITN distribution coverage (administrative)………………
Month/year of ITN distribution…………………………
ITN utilization rate (if available)………………………..
IRS coverage ……………………………………………

Monthly out patient malaria report from health facility

| Month | Total OPD | Total malaria cases | Total Confirmed cases | Total Plasmodium falciparum |
|---|---|---|---|---|
| July | | | | |
| August | | | | |
| September | | | | |
| October | | | | |
| November | | | | |
| December | | | | |
| January | | | | |
| February | | | | |
| March | | | | |
| April | | | | |

| | | | | |
|---|---|---|---|---|
| May | | | | |
| June | | | | |

Monthly climate variables data collection by village for 1999, 2000, 2001 EFY

| Month | Monthly mean minimum temperature | Monthly mean Maximum temperature | Monthly cumulative rainfall | |
|---|---|---|---|---|
| July | | | | |
| August | | | | |
| September | | | | |
| October | | | | |
| November | | | | |
| December | | | | |
| January | | | | |
| February | | | | |
| March | | | | |
| April | | | | |
| May | | | | |
| June | | | | |

## *Annex 2: Data entry format*

| Village | Year | Months 1=Sept 2=Oct 3=Nov 4=Dec | Woreda Report Of Malaria outbreak | Mean Min Temp without lag | Mean Min Temp one month lag | Mean Min Temp two month lag | Mean Max temp without lag | Mean Max Temp with 1 months | Mean Max Temp with 2 months lag | Cumm rainfall Without lag | Cumm rainfall with 1 month lag | Cumm rainfall with 2 months lag | ITN coverage | IRS coverage | IRS coverage categorized as 0 for villages no spraying, 1 b/n 0 and 34%, 2 b/n 35 and 74, 3 for ≥75% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gumbere | 2006 | September | 0 | | | | | | | | | | | | |
| Gumbere | 2006 | October | 0 | | | | | | | | | | | | |
| Gumbere | 2006 | November | 0 | | | | | | | | | | | | |
| Gumbere | 2006 | December | 0 | | | | | | | | | | | | |
| Gumbere | 2007 | September | 0 | | | | | | | | | | | | |
| Gumbere | 2007 | October | 0 | | | | | | | | | | | | |
| Gumbere | 2007 | November | 0 | | | | | | | | | | | | |
| Gumbere | 2007 | December | 0 | | | | | | | | | | | | |
| Gumbere | 2008 | September | 1 | | | | | | | | | | | | |
| Gumbere | 2008 | October | 1 | | | | | | | | | | | | |
| Gumbere | 2008 | November | 1 | | | | | | | | | | | | |
| Gumbere | 2008 | December | 1 | | | | | | | | | | | | |

## *Annex 3 Guide for focus group discussion (FGD) with community members*

**Introduction**

Thank you for coming to this session, your presence is very important.

(Description: what a focus group is, it is like an opinion survey, but very general, broad question)

Purpose: We will be discussing your reaction/ perception and experience about the malaria situation in your areas and what factors will contribute for increase level of transmission.

- All your ideas, comments, and suggestions are of great interest for us.
- There is no right and wrong answers, all comments both positive and negative, are well come.
- Please disagree one another when necessary. We would like to have many points of view

Ask each participant to introduce him/her self

- Name
- Some thing about one's self, work, residence, experiences, etc

1. I begin with, how do you see the magnitude of malaria problem in your area, how do you see it comparing with the previous 3 to 5 years?

2. What do you use to prevent and control malaria? Which ones are more effective? What need to be improved?
    - Do you have ITN? When was net distribution was done ? do you use them/? What about IRS? Did your houses spray yearly

3. Do they get treatment when patient suspect malaria? Where they get treatment? Any problem related to the service?

4. Was there malaria epidemic happen in your area?  What factors contribute for increase or decrease of malaria in your area?

- How the rain, temperature was this year compare to the previous ears?

5. What should be done to reduce malaria morbidity and mortality?

### *Annex 4: Guidance for FGD in Afan Oromo*

## Akkata Maree tutaa ummataf

**Seensa**

Bakka kanatti argamuu kessanif heduu isin galatomfana, argamuun kessan heduu barbachisadha

Maree tutaa: Jechuun waluma galaafi baldhinaan yaaada wal jijiirudha

Kayyoo

Yeroo kana ilaalcha busaarratti qabdan , muxanno fi beekumsa busaa naanno kessan kessaa akkasumas sababawan ka'umsa busaafi babali'ina isaa irratti ni mari'ana

- Yaadafi ilaalcha busaa isin qabdan yoo nuf himaachistan heduu nu gargaara
- Deebi dgugaa ykn sobaa kan jedhamu hin jiru, yaadni isin nuuf hirtan hundumtuu fudhatama qaba
- Yaada namni tokko kennerratti hundahudhan waligalteera gahun garii mitti yaada tokkoraa gahuuf mormuunis ni dandahama

***Waan hunduma dura wal baruun barbachisadha***

( maqaa, eenyumaa ofii, hoji ofii, bakka jirenyaa fi kkf

1. haali busaa yeroo amma nanoo kessan kessati maal akka fakkatu , wagoota3-5 darbani wajiin waliin madaluudhan
2. dhibee busaa off irraa ittisudhaf maal fayyadamtu? Isaa kamtu iraa heduu fayyada? Maaltu akka foyyahu barbaadu?

- Saphanaa siree qabduu? Yoom isiniif kename? Itti fayadamaa jirtuu? Biiffaa keemikaala beektu? Mani kessan bifameera?

3. yeroo busaadhan dhibamtan qoricha ni argatu? Eesaa argattu? Kana ilaalchise rakkon isin quunamee jira?
4. Werreeri dhibee busaa ka'e beeka? Sababa heddumachu ykn xiqaachu isaa ni beektu?
   - Roobni, ho'inii fi haali qileensa bara kana bara yeroo darbanii wajiin yeroo madaltan maal fakkata?
5. Dhukkuba dhibe busaa akkasumas lubuu balaa kanaan badu xiqeesuf maaltu godhamuu qaba jetanii yaaddu?

FGD Matrix for analysis

**Summary of 2 FGDs at B/ketchema (S.Checkorsa woreda of Jimma zone), Jaresso (West wollega zone)**

| Serial number | Questions | Response |
|---|---|---|
| 1 | Magnitude of malaria problem in the last three years | There was decline of malaria cases in the previous years except what is happening this year.<br>The decline was due to interventions such as spraying of houses by chemicals, net distribution in 2006, keeping the surrounding clean. Five years ago the disease was affecting our people in large number. |
| 2 | What do you use to prevent and control malaria | Draining of water holding areas including on "Enset" trees, house spraying of chemicals, bed nets, social mobilization for keep cleanness of source of water (spring) and draining water containing areas around the spring, separate places for cattle's at house. |
| 4 | When was mosquito nets distributed in your village? | 2006 (1998 EC, September 1999 EC) and in Gumbore village, second round of net distribution was done during 2008 malaria outbreak but the quantity was small and the distribution was done to pregnant women, children under five years of age and some community members.<br>**"The disease is common among those who don't have bed net,"** as one participant reported in Gombore village of Ameya woreda. |
| 5 | Do you use nets? | **We are using nets. The nets are old and due to washing & the** |

| | | |
|---|---|---|
| | | **chemical now is not working, not able to kill the insects as it used to be before**. |
| 6 | What about IRS, did your house sprayed yearly? | Sprayed yearly, currently we are expecting spraying to be conducted soon. |
| 7 | Where do get treatment service for malaria? Was drug available for treatment? | Health institutions- health posts. Received malaria treatment after investigation. Some of the participants were reported that in some cases people may not complete the treatment course when they get some relief and keep the rest of the drug for some other time. |
| 8 | Was malaria epidemic happen in this village? | In the two of the three FGDs it was agreed that the outbreak was in 2001, but in the other FGD participant were saying that the outbreak was in 2000. in all cases the health workers intervened by distributing drugs to the community. |
| 9 | Which factors contributed? | - poor drainage and lack of environment cleanness<br>- untimely rain<br>- bed nets distributed three years back are now old and not helpful in preventing malaria . |
| 10 | How was the rain, temperature in September to December in 2001? | - **untimely rain was reported in B/ketchema** ( S.Chekoresa woreda of Jimma zone) |
| 11 | What should be done to reduce malaria morbidity and mortality? | - Drainage water holding areas<br>- House hold sanitations<br>- **Availing nets for those who don't have and also replace the old ones.**<br>- Teach communities to always use bed nets.<br>- Continue spray of DDT<br>- Using house hold remedies like Onion and visit near by health facilities. |

FGD Matrix for analysis

**Summary of one FGD Gumbere (Ameya woreda of South West Shoa)**

| SN | Questions | Response |
|---|---|---|
| **1** | Do the HEWs teach you about malaria and provide you anti malarial drugs? | Yes, they teach us about malaria, how to drain and avoid collected waters that can help for mosquito breeding and other diseases, like diarrhea and personal hygiene |
| 2 | From where do you get anti malarial drugs? | We get from health post. We get it freely; we do not pay for the drugs. |
| 3 | What are the causes of malaria epidemic in your opinion in this area? | The same as what was mentioned previously by other people and in addition the ITNs were not distributed to the whole people. |
| 4 | Do you think ITNs protect from malaria? When the mosquito net was was distributed? And for how many years it protect? | Yes, it protects from malaria, we have collected in 1998 EC and it will work only for two years. |
| 5 | What control strategies do you use to control malaria? | a. Draining and avoid water collections<br>b. Use mosquito nets properly<br>c. Take drugs when HEWs prescribe. |
| 6 | Three years after you mosquito nets are distributed, malaria has increased this year (during September), and what do you think the possible cause? | a. Climate change and unusual rain fall. There was much rain than expected.<br>b. The first year we collect it was killing everything, like lice, flies and others, but this year it is not.<br>c. Our mosquito nets are too old to kill mosquitoes after we wash.<br>d. Many water collections for mosquito breeding in our area |
| 7 | What has to be done to control malaria transmission in your area? | a. Drain and clean water collections.<br>b. Properly use mosquito nets.<br>c. Visit HEWs when we feel sick.<br>d. Distribute more mosquito nets and replace the old once. |
| 8 | What drugs do we use for those | We get treatment according to the age with anti malarial drugs |

| | | |
|---|---|---|
| | children who can not swallow tablets? | prepared for them like chloroquine syrup but not injection. the injection will be given at higher level |
| 9 | If you brief us about the present status of anti malarial drugs, ITNs and current climate situation. Because this days malaria is confusing us with other diseases | About drugs the woreda health heads are here and they will give us the answer, and ITNs planned for the woreda will arrive soon |
| 10 | What are the measure causes for current malaria increase in this area? | a. climate changes like the expected rain fall in the rainy season was not as usual, it rained few, water collected in various areas and mosquito population was high to transmit malaria<br>b. Improper use of distributed ITNs by the community.<br>c. c. Improper handling of IRS |
| 11 | What measures has to be taken not to get malaria? | a. Drain and clean water collections in the area, avoid items that can collect water like old tires, tins, pots and others<br>b. Proper use of ITNs as per the orientation and health education given by health workers<br>Handle properly sprayed walls, not to wash, not to paint or replaster. |
| 12 | What do you expect from the nearest health facilities, and what advice do you expect? | a. When we feel seek visit the nearest health facility as soon as possible<br>b. Get examined and checked by health worker for malaria.<br>c. If it is malaria collect anti malarial drug and take as it is recommended by the health worker |